Arizona Department of Water Resources
Hydrology Division

Prescott Active Management Area
2001-2002 Hydrologic Monitoring Report

August 21, 2002

by

ADWR Hydrology Division - Technical Support, Field Services and Modeling Sections
ADWR Groundwater Management Division - Prescott AMA

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Introduction

This report presents hydrologic monitoring data and related information that has been compiled by the Arizona Department of Water Resources (ADWR) for the Prescott Active Management Area (AMA) during the period from January, 2001 through May, 2002. This year's report includes annual water level measurement data collected at 115 index well sites. Continuous water level data (hydrographs) are presented from 21 of the index well sites that are equipped with pressure transducer equipment. The report provides compilations of surface water, precipitation, pumpage and recharge data and describes the recent drilling of three monitor wells in data-deficient areas of the AMA. The report also discusses the recent update of the Prescott AMA groundwater flow model and presents a conceptual water budget for the Prescott AMA for calendar year 2001.

This report is the second in a series of upgraded hydrologic monitoring reports that describe hydrologic data and conditions and related activities for the Prescott AMA. The report is the latest in a series of groundwater monitoring reports that were initiated, in part, to fulfill the groundwater monitoring requirements for the Prescott AMA that were established by the 1995 Assured Water Supply rules. The upgraded report format also reflects suggestions and recommendations made during the 1998 "Prescott AMA Safe-Yield Determination" to enhance groundwater monitoring and groundwater modeling activities in the AMA. The report provides the ADWR with an excellent opportunity to keep water users posted on current hydrologic conditions and data collection and data analysis activities that support the water management goals of the AMA. This report may be downloaded as a PDF file from ADWR's website at: http://www.water.az.gov/.

Groundwater Data and Conditions 2001-2002

The measurement of water levels is an important data collection activity that provides information about changing groundwater storage conditions in the regional aquifer system. In general, rising water levels are indicators of increasing groundwater storage conditions, while declining water levels are indicators of decreasing groundwater storage. Groundwater conditions in the AMA's regional aquifer system were assessed by measuring the depth to water at 101 well sites located within the AMA and 14 well sites adjacent to the AMA. ADWR Field Services staff conducted the water level measurements during the period 02/09/2002 to 05/28/2002. The depths to water, water level changes, and water level elevations are summarized in Table 1.

Decreasing groundwater storage trends were observed at the majority of the 84 wells that were measured in both 2001 and 2002 and that were used for statistical analysis (Figure 1). For completeness, all data collected by the ADWR during 2002 have been presented in Table 1. However, it should be noted that not all wells that were measured in both 2001 and 2002 were used for the statistical analysis because of various non-standard well site conditions, such as cascading water, or recent or nearby pumping that could potentially bias a water level measurement, typically resulting in measurements that overstate the actual annual regional water level decline. Although some of the well data were not used for the statistical analysis it should be pointed out that the data that were excluded were still often generally reflective of regional and local conditions. The statistical analysis of the water level data indicates that 73 of the 84 wells (87 percent) that were measured in both 2001 and 2002 showed water level declines that ranged from –0.1 to –42.3 feet (Table 2). The mean decline was –3.9 feet and the median decline was –2.3 feet.

Increasing groundwater storage trends were observed in 10 of the 84 wells (12 percent) that were used for statistical analysis. Water level increases ranged from +0.2 to +5.8 feet (Table 2). The mean increase was +1.7 feet and the median increase was +0.5 feet. One well of the 84 wells (about 1 percent) showed no change in water level.

Water level declines were observed in most parts of the AMA. Declines ranged from less than -2 feet to over -8 feet in wells that were measured that penetrate the Upper Alluvial Unit (UAU) and Lower Volcanic Unit (LVU) aquifers located in the northwestern portion of the Little Chino (LIC) sub-basin near the Town of Chino Valley and Del Rio Springs (Townships 16 and 17 North, Range 2 West). Declines ranged from less than -1 foot to over -11 feet in wells that penetrate the UAU, LVU and/or bedrock in the Williamson Valley area (Township 15 North, Ranges 2 (western portion) and 3 West). Declines ranged from less than -1 to –42 feet in wells that penetrate the UAU, LVU and/or bedrock in the Lonesome Valley and Indian Hills-Coyote Springs areas of the Little Chino sub-basin (Townships 15 and 16 North, Ranges 1 East and 1 West).

Water level declines in wells that are completed in the LVU in the northwest portion of the Upper Agua Fria (UAF) sub-basin in the Prescott Valley area (Township 14 North, Range 1 West, Section 10) were excluded from the statistical analysis due to nearby pumping conditions (Table 1). However, it is likely that the annual declines in these wells were on the order of -15 to -20 feet, based on a review of the hydrograph for piezometer well, B(14-1) 10ADB1 PZ1 (see

Appendix A). Water level declines ranged from less than -1 foot to about –11 feet in wells located in other parts of the Upper Agua Fria sub-basin (Townships 13 and 14 North, Ranges 1 East and 1 West).

Water level increases ranging from less than +1 foot to +2 feet were observed in wells that penetrate the UAU and undifferentiated volcanic rocks in the Upper Agua Fria sub-basin (Townships 13 and 14 North, Ranges 1 East and 1 West). The water level increased less than 1 to 6 feet in two wells located near the Town of Chino Valley. The water level was observed to increase by less than +1 foot in one well in the Lonesome Valley area.

Figure 1 Water level changes in the Prescott AMA 2001 to 2002

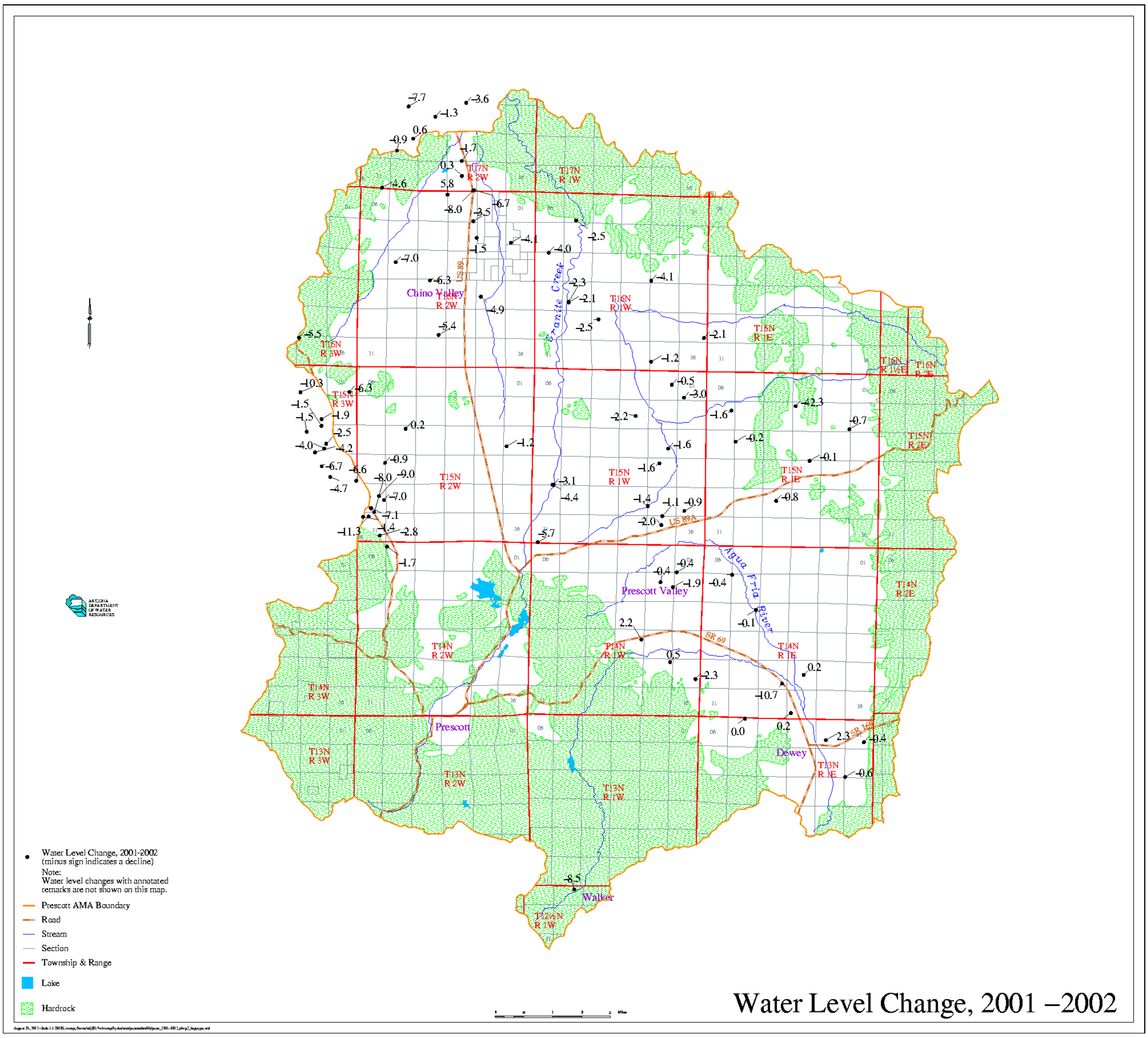


Table 1 Summary of water level data Prescott AMA and vicinity 1994 to 2002
(Water level changes rounded to nearest 0.1 foot)

SITE_ID	LOCAL_ID	1994 DTW	1999 DTW	2000 DTW	2001 DTW	2001 REMARK	2002 MEASUREMENT DATE	2002 DTW	2002 REMARK	94-02 CHG	99-02 CHG	00-02 CHG	01-02 CHG
343153112122901	A-13-01 01DCA	209.5	207.6		208.1		04/25/2002	208.45		1.0	-0.9		-0.4
343157112135401	A-13-01 02CAD	86.4	82.9	83.7	83.4		03/27/2002	81.1		5.3	1.8	2.6	2.3
343233112164901	A-13-01 05ABB		151.7	152	152.63		02/14/2002	152.65			-0.9	-0.7	0.0
343050112130901	A-13-01 12CCC	69.8	71		72		04/08/2002	72.6		-2.8	-1.6		-0.6
343028112135701	A-13-01 14BDC1	28.65	30.5	30.5	30		04/23/2002	129.6	P	-101.0	-99.1	-99.1	-99.6
343028112135702	A-13-01 14BDC2		51.6	39.6	33.4		04/23/2002	34.9	S		16.7	4.7	-1.5
343652112172101	A-14-01 08BBB	197.6	200.6	199.3	199.43		02/14/2002	199.87		-2.3	0.7	-0.6	-0.4
343529112162201	A-14-01 17AAD	113.3	115.9	116.29	116.95		02/12/2002	117.05		-3.8	-1.1	-0.8	-0.1
343434112145201	A-14-01 22CAD						02/12/2002	76.4					
343353112144101	A-14-01 27ACC	48.3	43.8	42.92	42.82		05/13/2002	42.58		5.7	1.2	0.3	0.2
343415112161401	A-14-01 28BBB	52.1	63.6	63.1	48.1		03/27/2002	70.7	*	-18.6	-7.1	-7.6	-22.6
343333112160201	A-14-01 28CDC		173.6		161.9		04/24/2002	200.2	R		-26.6		-38.3
343337112152901	A-14-01 28DAC2		86.1		92.1		02/12/2002	102.8			-16.7		-10.7
343244112150901	A-14-01 34CCA	66.7	73.9	75.5	77.5		04/09/2002	77.26		-10.6	-3.4	-1.8	0.2
344148112172701	A-15-01 07ADA	458.7	463.7	465.5	467.5		04/24/2002	469.1		-10.4	-5.4	-3.6	-1.6
344157112150701	A-15-01 10BBB2				92.4		04/23/2002	134.7					-42.3
344117112130901	A-15-01 11DDD	212.7	216.6	217.2	217.8		04/10/2002	218.5		-5.8	-1.9	-1.3	-0.7
344052112171701	A-15-01 17BCC	313.8	314.2	314.1	314.1		04/10/2002	314.31		-0.5	-0.1	-0.2	-0.2
344029112143501	A-15-01 22ABB	57.9	60.2	60.86	61.88		02/14/2002	61.98		-4.1	-1.8	-1.1	-0.1
343906112154701	A-15-01 28ACC	312.9	313.2	313.89	314.42		02/12/2002	315.19		-2.3	-2.0	-1.3	-0.8
342722112225901	B-12H01 20ACD		69.9	68.7	67.6		02/09/2002	76.1			-6.2	-7.4	-8.5
343655112192201	B-14-01 01CCC		336.4	336.3	337.5		04/24/2002	337.9			-1.5	-1.6	-0.4
343634112205201	B-14-01 10ACA	477.8	583.6	603.2	620.6	C	04/24/2002	662.5	S	-184.7	-78.9	-59.3	-41.9
343641112204202	B-14-01 10ADB1 PZ1		566.3	585.5	603.29		02/12/2002	634.34	S		-68.0	-48.8	-31.1
343641112204203	B-14-01 10ADB1 PZ2	331.5			323		04/24/2002	322.7	S	8.8			0.3
343640112204201	B-14-01 10ADB2			590.1	611.1		04/24/2002	653.9	S			-63.8	-42.8
343610112203201	B-14-01 10DDA	522.2	636.9	654.4	673.5	C	04/24/2002	686.7	C	-164.5	-49.8	-32.3	-13.2
343637112195701	B-14-01 11ACB	341.3	342	340.8	341.9		04/09/2002	342.33		-1.0	-0.3	-1.5	-0.4
343628112193001	B-14-01 11DAA	327.5	328.5	327.5	328.6		04/24/2002	330.5		-3.0	-2.0	-3.0	-1.9
343453112203401	B-14-01 22ADA	325.9		326.6	333.9		04/09/2002	331.7		-5.8		-5.1	2.2
343343112183801	B-14-01 25DAC	45.4	57.2	56.6	59.5		04/09/2002	61.8		-16.4	-4.6	-5.2	-2.3
343413112193401	B-14-01 26AAA	209.3	212	212.5	213.5		04/09/2002	213.05		-3.8	-1.1	-0.6	0.4
343734112295501	B-14-02 05BBC		175.3	175.5	176.7		04/10/2002	178.4			-3.1	-2.9	-1.7
344208112191201	B-15-01 01CDC	366.8	370.3	371.9	372.8		03/27/2002	375.8		-9.0	-5.5	-3.9	-3.0
344233112193801	B-15-01 02ADC	323.1	327	328.3	330.7		04/11/2002	331.2		-8.1	-4.2	-2.9	-0.5
344134112223501	B-15-01 08DAA						02/12/2002	377.5					
344136112205601	B-15-01 10DBB				307.5		04/11/2002	309.73					-2.2
344038112194401	B-15-01 14DBD	323.5	328.8	330.68	332.63		02/14/2002	334.2		-10.7	-5.4	-3.5	-1.6
343930112235301	B-15-01 19DCD1	220.8	225.3	236.6	226.4		04/10/2002	229.5		-8.7	-4.2	7.1	-3.1
343930112235601	B-15-01 19DCD2		370.5		374.6		04/10/2002	379.0			-8.5		-4.4
344011112200901	B-15-01 23BAD	328.7	336.3	339.3	340.2		04/11/2002	341.8		-13.1	-5.5	-2.5	-1.6
343847112190401	B-15-01 25CDB	292.8	296	296.3	297.1		03/27/2002	298		-5.2	-2.0	-1.7	-0.9
343854112202701	B-15-01 26CBC1		399.2	398.27	399.9		02/12/2002	401.27			-2.1	-3.0	-1.4
343836112195501	B-15-01 26DCC				447.7	V	04/10/2002	448.75					-1.1

SITE_ID	LOCAL_ID	1994 DTW	1999 DTW	2000 DTW	2001 DTW	2001 REMARK	2002 MEASUREMENT DATE	2002 DTW	2002 REMARK	94-02 CHG	99-02 CHG	00-02 CHG	01-02 CHG
343746112242601	B-15-01 31CCD		341.7	341.8	344.1		04/11/2002	349.8			-8.1	-8.0	-5.7
343820112195701	B-15-01 35ABD				379.5		04/10/2002	381.5					-2.0
344038112253701	B-15-02 13CCB	363.7	365.1	365.5	367.5		04/08/2002	368.7		-5.0	-3.6	-3.2	-1.2
344106112291501	B-15-02 17ABA	297.2	295.5	294.9	294.7		03/29/2002	294.5		2.7	1.0	0.4	0.2
344005112300201	B-15-02 19ADA		334.4	334.4	334.5		04/10/2002	335.4			-1.0	-1.0	-0.9
343928112301401	B-15-02 19DDC		308.1	308.7	309.5		04/09/2002	312	R		-3.9	-3.3	-2.5
342020112270101	B-15-02 22AAB						02/11/2002	370.3					
342020112270102	B-15-02 22AAB						04/22/2002	335					
343905112301401	B-15-02 30ADC		119.5	123.1	128.7		04/09/2002	137.7			-18.2	-14.6	-9.0
343843112303101	B-15-02 30CDA		156.6	159.7	166.7		04/09/2002	173.8			-17.2	-14.1	-7.1
343858112300301	B-15-02 30DAA		144.7	148.8	154.2		04/10/2002	161.2			-16.5	-12.4	-7.0
343836112302401	B-15-02 30DCB		148.5	151.9	157.9		04/09/2002	165.9			-17.4	-14.0	-8.0
343829112303501	B-15-02 31BAD1		210.8	216.64	222.04		02/15/2002	233.31			-22.5	-16.7	-11.3
343827112304801	B-15-02 31BBD		166.3	169.6	187.9		04/09/2002	189.3			-23.0	-19.7	-1.4
343754112301101	B-15-02 31DDB		208.3	209.2	210.9		04/09/2002	213.7			-5.4	-4.5	-2.8
344241112312201	B-15-03 01DCD	102	95.1		94		04/09/2002	100.3		1.7	-5.2		-6.3
344122112322201	B-15-03 11DDB		64.5	66.6	69		04/11/2002	70.9			-6.4	-4.3	-1.9
344108112311001	B-15-03 13AAA		206.8	204	205.8		04/11/2002		O				
344147112313201	B-15-03 13ACC		217.4	217.1	217.2		04/10/2002	221.4	R		-4.0	-4.3	-4.2
344110112322201	B-15-03 14AAB				51.5		04/10/2002	53					-1.5
344059112325401	B-15-03 14BAD				44.8		04/09/2002	46.3					-1.5
344022112323501	B-15-03 14CDD				3.7		04/10/2002	7.9					-4.2
344038112321101	B-15-03 14DAD				49.7		04/10/2002	52.2					-2.5
344029112321501	B-15-03 14DDA				14		04/10/2002	18					-4.0
343957112322001	B-15-03 23ADC		54.7	54.7	52.6		04/11/2002	59.3			-4.6	-4.6	-6.7
343938112320101	B-15-03 24CCB		84	84.9	85.1		04/11/2002	89.8			-5.8	-4.9	-4.7
343932112310401	B-15-03 24DDD		140.44	144.14	149.2		04/10/2002	155.8			-15.4	-11.7	-6.6
344210112330901	B-15-03S02CCB				15.7		04/12/2002	26					-10.3
344727112231201	B-16-01 05CDD	174.9	180.89	180.5	184.1		05/14/2002	186.6		-11.7	-5.7	-6.1	-2.5
344628112174901	B-16-01 07CDD	158.4	163.9	165.6	167.9		05/14/2002	171.9		-13.5	-8.0	-6.3	-4.0
344540112202601	B-16-01 14CCC	284.7	290.3	291.8	293.7		05/14/2002	297.8		-13.1	-7.5	-6.0	-4.1
344501112232601	B-16-01 20CAC		222.2	220.1	223.6		04/08/2002	225.9			-3.7	-5.8	-2.3
344459112232601	B-16-01 20CBD1	45.2	44.4		49.3		04/22/2002	51.4		-6.2	-7.0		-2.1
344520112194301	B-16-01 23ACA						02/13/2002	343.6					
344358112182901	B-16-01 25DDA	409.3	414.6	415.9	418.1		04/11/2002	420.15		-10.9	-5.6	-4.3	-2.1
344429112222001	B-16-01 28BCA	267.3	272.7	274.7	276.2		04/11/2002	278.7		-11.4	-6.0	-4.0	-2.5
344314112202401	B-16-01 35CBC	305.8	310.5	311.9	313.4		02/14/2002	314.62		-9.3	-4.6	-3.2	-1.2
344738112253301	B-16-02 01CBD	57.2	63.6	64.7	67.2		05/15/2002	78	*	-20.8	-14.4	-13.3	-10.8
344809112275201	B-16-02 03BBB1	51.5	55.7	56.7	57.6		03/26/2002	51.8		-0.3	3.9	4.9	5.8
344723112265701	B-16-02 03DDC4	37.6	46.7	50	52.4		03/27/2002	55.9		-18.3	-9.2	-5.9	-3.5
344704112291601	B-16-02 08ACA	106.35	105	107	109.4		05/14/2002	116.2	*	-9.8	-11.2	-9.2	-6.8
344629112283401	B-16-02 09CDC	166.8	175.8	176.7	179.7		05/28/2002	185.1	*	-18.3	-9.3	-8.4	-5.4
344653112264901	B-16-02 11CBB1	53.2	55.91	56.64	58.45		02/11/2002	59.9		-6.7	-4.0	-3.3	-1.5
342658112244601	B-16-02 12ADD	110.2	115.6	117.1	118.1		05/15/2002	120.2	*	-10.0	-4.6	-3.1	-2.1
344645112253401	B-16-02 12CBD		76.9	78.41	81.01		02/13/2002	85.11			-8.2	-6.7	-4.1
344603112264001	B-16-02 14BCC	154.9	136.9	145.8	151	V	05/15/2002	157.1	V	-2.2	-20.2	-11.3	-6.1
344540112264501	B-16-02 14CCC		173.1		179.3		05/14/2002	183.4	*		-10.3		-4.1
344543112262201	B-16-02 14CDA	163.7	152.5	163.4	171.1	V	05/14/2002	179.3	V	-15.6	-26.8	-15.9	-8.2

SITE_ID	LOCAL_ID	1994 DTW	1999 DTW	2000 DTW	2001 DTW	2001 REMARK	2002 MEASUREMENT DATE	2002 DTW	2002 REMARK	94-02 CHG	99-02 CHG	00-02 CHG	01-02 CHG
344622112275701	B-16-02 16AAD		155.3	157.8	160.4		05/15/2002	163.9	*		-8.6	-6.1	-3.5
344607112294301	B-16-02 17BDC	166.2	175.5	176	178.4		03/26/2002	185.4		-19.2	-9.9	-9.4	-7.0
344534112282901	B-16-02 21BAA1	216.8	223.9	226.4	228.7		03/27/2002	238.2	*	-21.4	-14.3	-11.8	-9.5
344535112283001	B-16-02 21BAA2	218.6	225.6	228.16	230.42		02/11/2002	236.69		-18.1	-11.1	-8.5	-6.3
344458112270601	B-16-02 22DBD		212.2	214.6	217.5	V	04/09/2002	225.9	*		-13.7	-11.3	-8.4
344507112263801	B-16-02 23CBA		167.6	169.2	171.95		02/11/2002	176.83			-17.7	-16.1	-4.9
344422112283201	B-16-02 28BDD	287	301.9	304.5	309		04/08/2002	316.5	*	-29.5	-14.6	-12.0	-7.5
344357112280901	B-16-02 28DDC	288.1	295.7	296.4	301.02		02/11/2002	306.38		-18.3	-10.7	-10.0	-5.4
344347112271001	B-16-02 34ABA2	265.1	272.4	274.2	276.6		03/29/2002	284.5	R	-19.4	-12.1	-10.3	-7.9
344304112254701	B-16-02 35DDD	297	302.5		306.5		04/11/2002	310.4	*	-13.4	-7.9		-3.9
344348112331401	B-16-03 35BBB		115	115.5	117.8		04/10/2002	123.3			-8.3	-7.8	-5.5
345109112264401	B-17-02 14CCA			93.47	92.6		03/30/2002	93.31				+0.2	-0.7
345048112292201	B-17-02 20ABD				177.2		05/28/2002	184.9					-7.7
345030112282301	B-17-02 21ACC				112.2		05/28/2002	113.5					-1.3
345056112271601	B-17-02 22ABB				23.7		05/28/2002	27.3					-3.6
344950112291101	B-17-02 29ADC			230.6	232.4		05/28/2002	231.8				-1.2	0.6
344928112294601	B-17-02 29CAC		456		457.6		05/28/2002	458.5			-2.5		-0.9
344846112271401	B-17-02N34ACC	10.7	12.9	11.1	12.7		03/26/2002	12.4		-1.7	0.5	-1.3	0.3
344819112265701	B-17-02N34DDD1	4.6		10.68	12.7		02/11/2002	20.71		-16.1		-10.0	-8.0
344819112265601	B-17-02N34DDD3	30.1	35.2	34.9	35.9		03/26/2002	42.6		-12.5	-7.4	-7.7	-6.7
344821112301701	B-17-02S31ABA		498.8		501		05/28/2002	496.4			2.4		4.6
344820112272701	B-17-02S34ABB				1.5		05/28/2002	25.6	S				-24.1
344917112273101	B-17-02W27DCC	9.2	11.6	12.23	12.4		02/13/2002	14.1		-4.9	-2.5	-1.9	-1.7

CHG = change in depth to water

DTW = Depth to Water (in feet)

GWSI Remarks: C = cascading water
O = obstruction
P = pumping
R = recently pumped
S = nearby pumping
V= foreign material (oil)

Other Remarks: * = probable, but unobserved nearby pumping

Note (1) Wells with water level measurements annotated with remarks were not used in statistical analysis.
Note (2) Table 1 includes annual water level measurements that were taken at the 21 index wells that are equipped with pressure transducer equipment (Table 2)

Table 2. Statistical summary of water level change data in the Prescott AMA and vicinity (1995 to 2002)

Period of Change →	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002
Number of Wells Used Analysis	16	17	44	43	87	92	84
Number of wells showing Increases in water levels	1	4	10	7	21	9	10
Sum of increase (feet)	+0.6	+18.0	+33.0	+39.5	+22.7	+35.7	+16.9
Minimum increase (feet)	+0.6	+2.0	+0.1	+0.1	+0.1	+0.1	+0.2
Maximum increase (feet)	+0.6	+7.0	+9.2	+16.3	+4.8	+15.0	+5.8
Mean of increases (feet)*	+0.6	+4.5	+3.3	+5.6	+0.9	+4.0	+1.7
Median of increases (feet)**	+0.6	+4.5	+1.5	+4.4	+1.2	+1.1	+0.5
Number of wells showing Declines in water levels	15	10	34	35	63	82	73
Sum of declines (feet)	-54.3	-23.0	-71.4	-51.5	-188.2	-300.1	-288.8
Minimum declines (feet)	-0.5	-1.0	-0.2	-0.1	-0.1	-0.1	-0.1
Maximum declines (feet)	-13.4	-6.0	-12.6	-7.5	-19.6	-21.0	-42.3
Mean of declines (feet)*	-3.6	-2.3	-2.1	-1.5	-3.0	-3.7	-4.0
Median of declines (feet)**	-2.2	-1.5	-2.1	-1.2	-1.6	-2.25	-2.3
Number of wells showing no Change in water levels	0	3	0	1	3	1	1

* The mean of increases or declines is the arithmetic average of each group of measurements (that is, the average change in water level for wells with measured increases in water level or the average change in water level for wells with measured decreases in water level). For example, the sum of all measured water level increases in the 10 wells that showed increases between 2001 and 2002 was +16.9 feet. The mean of increases, +1.7 feet, was calculated by dividing the sum of increases (+16.9 feet) by the number of measurements that showed increases (10).

** The median of increases or declines is a statistical measure of the central value of each group of measurements. Half of the measurements in each group are less than the median, and half of the measurements in each group are greater than the median. For example, the median decrease of -2.3 feet equals the 37th ranked well of the 73 total wells that showed decreases between 2000 and 2001.

Pressure Transducer Data

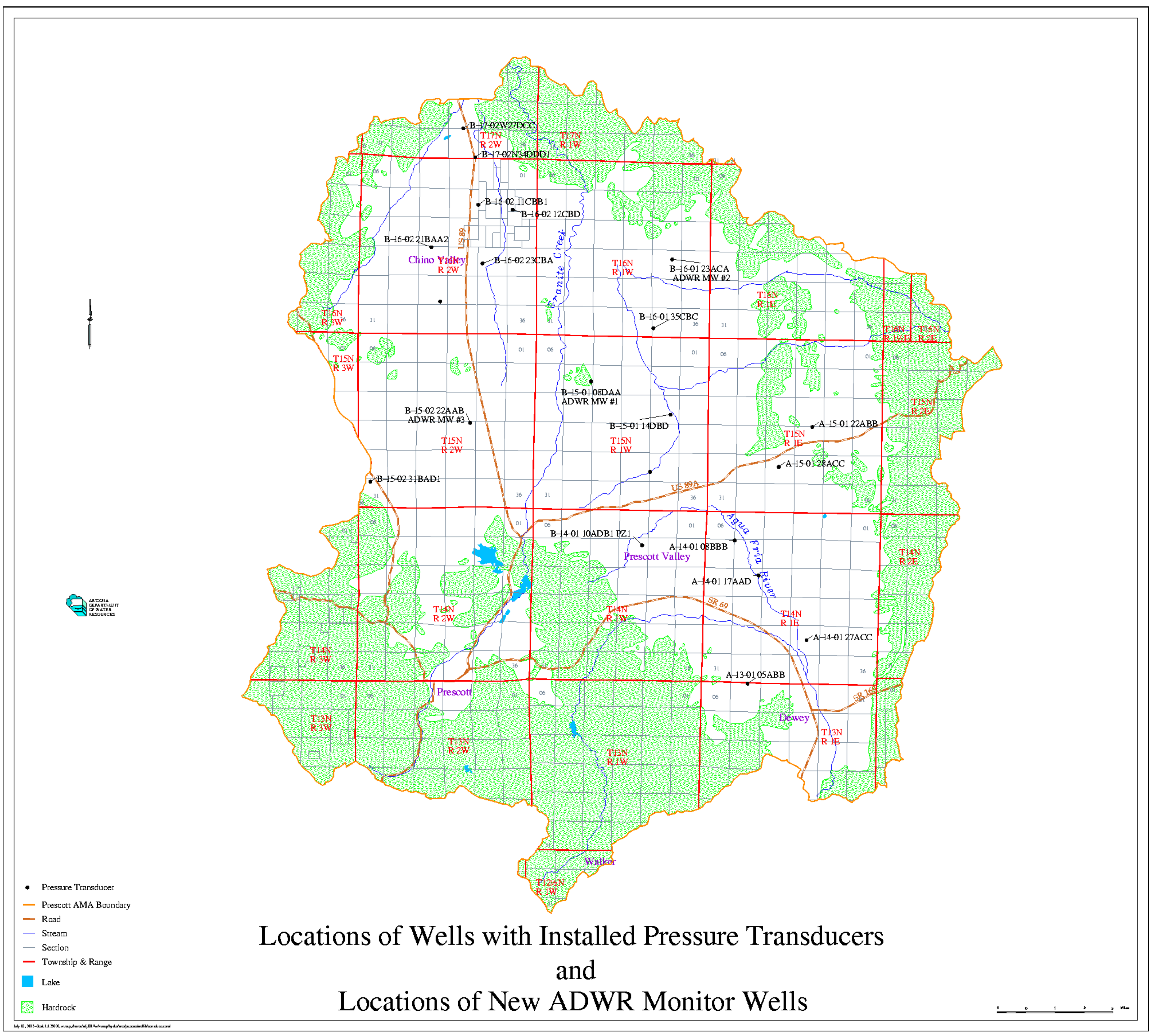
Another important component of the water level monitoring program is the network of 21 pressure transducer wells that have been established in strategic monitoring locations throughout the AMA (Table 3 and Figure 2). The pressure transducer data provide a daily record of water level fluctuations in key areas of the AMA where frequent water level monitoring is required. Typically, pressure transducers have been installed in unused wells where seasonal or sporadic water level fluctuations occur. In most cases the water level fluctuations reflect the effects of seasonal variations in groundwater pumpage and incidental recharge. In other cases, pressure transducers have been installed in wells located near major drainages to study the effects of runoff and flooding on natural recharge. Transducers have also been installed in wells located near Del Rio Springs to provide information on the correlation between groundwater levels and groundwater discharge. Transducers were also installed in the three new exploratory monitor wells that were drilled by the ADWR during the summer of 2001 in the Little Chino sub-basin (see section on well drilling for more details).

Hydrographs from the 21 pressure transducer wells are shown in Appendix A. Examination of the hydrographs reveals the cyclical nature of seasonal water level changes in many wells located primarily in the vicinity of the agricultural area of the Little Chino sub-basin (Townships 16 and 17 North, Range 2 West). Almost all of the hydrographs show a declining trend in water levels over their respective period of record (2000 to 2002).

Table 3 Prescott AMA pressure transducer wells

Site ID	Cadastral Location	Registry No.	Well Depth	Sub-Basin	Begining Date	Latest Date	Water Level Count
343233112164901	A-13-01 05ABB	55-502012	224	UAF	11/5/99	5/13/02	42,423
343652112172101	A-14-01 08BBB	55-536623	861	UAF	6/23/00	5/13/02	28,197
343529112162201	A-14-01 17AAD	55-613025	1,103	UAF	1/24/00	5/13/02	42,452
343353112144101	A-14-01 27ACC	55-613024	606	UAF	1/24/00	5/13/02	39,701
344029112143501	A-15-01 22ABB	55-519873	220	LIC	1/7/00	5/13/02	44,423
343906112154701	A-15-01 28ACC	55-614238	372	UAF	1/7/00	5/13/02	44,169
343641112204202	B-14-01 10ADB1 PZ1	55-519687	945	UAF	11/22/00	5/14/02	39,097
344134112223501	B-15-01 08DAA	55-587403	840	LIC	11/15/01	5/14/02	1,441
344038112194401	B-15-01 14DBD	55-523925	504	LIC	1/6/00	5/14/02	41,788
343854112202701	B-15-01 26CBC1	55-541372	610	LIC	1/7/00	5/14/02	33,183
342020112270101	B-15-02 22AAB	55-588619	1,240	LIC	12/7/01	5/15/02	1,273
343829112303501	B-15-02 31BAD1	55-638196	270	LIC	2/29/00	5/15/02	39,788
344520112194301	B-16-01 23ACA	55-587404	654	LIC	2/13/02	5/14/02	720
344314112202401	B-16-01 35CBC	55-805135	700	LIC	11/16/01	5/14/02	1,432
344653112264901	B-16-02 11CBB1	55-602559	125	LIC	5/26/00	5/15/02	37,866
344645112253401	B-16-02 12CBD	55-606300	644	LIC	1/21/00	5/15/02	43,364
344535112283001	B-16-02 21BAA2	55-604725	400	LIC	5/25/00	5/15/02	21,296
344507112263801	B-16-02 23CBA	55-800688	518	LIC	1/21/00	5/15/02	43,356
344357112280901	B-16-02 28DDC	55-628072	605	LIC	7/28/00	5/15/02	24,174
344819112265701	B-17-02N34DDD1	55-608242	722	LIC	2/25/00	5/15/02	58,799
344917112273101	B-17-02W27DCC	55-609768	750	LIC	10/29/99	5/15/02	72,506
				Total Water Level Measurements		=	701,448

Figure 2 Location of pressure transducer wells and new ADWR monitor wells



Surface Water Data 2001-2002

Surface water flow data provide important information concerning the amount of flow in rivers and streams. Many of the discharge measurements are direct indicators of the volume of groundwater that is discharged from the regional aquifer system to springs and river channels. Surface water data are also used to estimate the volume of water that is recharged to the aquifer system from streambed infiltration. Surface water data were obtained for the period January 1, 2001 to January 1, 2002 from 7 United States Geological Survey (USGS) stream gages that are located in or near the Prescott AMA. The surface water data are tabulated in Table 4. Daily discharge hydrographs for these gages are assembled in Appendix B.

Comparisons of recent (calender year 2001) discharge data were made to long-term annual mean discharge data and to median daily discharge data for the USGS gages with comparatively long periods of record. Comparisons were made for the gage on the Verde River near Paulden (09503700 – period of record 1963 to 2000), and for the gage on the Agua Fria River near Mayer (09512500 – period of 1940 to 2000).

The recent annual mean discharge at the USGS gage on the Verde River near Paulden (09503700) was 17,462 acre-feet per year, or about 56 percent of the long-term mean of 31,420 acre-feet per year (from 1963 to 2000) (USGS,2001). The recent median daily discharge was 24 cubic feet per second (cfs), or 96 percent of the long-term median daily discharge of 25 cfs (USGS, 2001). The median daily discharge at the Paulden gage is generally indicative of the typical baseflow of the Verde River at that location. The baseflow is primarily sustained by a series of springs that discharge groundwater to the channel of the Verde River and to the channel of lower Granite Creek a few miles upstream from the gage.

The recent annual mean discharge at the USGS gage on the Agua Fria River near Mayer (09512500) was 2,596 acre-feet per year, or about 16 percent of the long-term mean of 16,724 acre-feet per year (USGS, 2001). The recent median daily discharge was about 0.8 cfs, or about 36 percent of the long-term median daily discharge of 2.2 cfs (USGS, 2001). Baseflow conditions begin on the Agua Fria River near Humboldt. Daily surface water discharge measurements for the Agua Fria River gage near Humboldt (09512450) primarily reflect groundwater discharge (baseflow), however the gage discharge also reflects sporadic flows from infrequent precipitation/runoff events. Some reaches of the Agua Fria River between Humboldt and the Mayer gage are dry during average to dry years (Wilson, 1988).

Table 4 Summary of provisional USGS stream gage data for selected gages in and near the Prescott AMA (01/01/2001 - 01/01/2002)

Gage Description	Gage Number	Period of Record	Mean Daily Discharge (cfs) 01/01/01 to 01/01/02	Median Daily Discharge (cfs) 01/01/01 to 01/01/02	Minimum Daily Discharge (cfs) 01/01/01 to 01/01/02	Maximum Daily Discharge (cfs) 01/01/01 to 01/01/02	Annual Discharge (AF) 01/01/01 to 01/01/02
Del Rio Springs near Chino Valley	09502900	1996-2002	1.69	1.6	1.2	3.6	1,226
Granite Creek Near Prescott	09503000	1932-1947 1994-2002	3.79	0.42	0	1.69	2,743
Granite Creek at Prescott	09502960	1994-2002	3.1	0.19	0	129	2,260
Granite Creek below Watson Lake	09503300	1999-2002	0.88	0	0	62	636
Verde River near Paulden	09503700	1963-2002	24.12	24	21	40	17,462
Agua Fria River near Humboldt	09512450	2000-2002	1.85	1.8	0.2	33	1,343
Agua Fria River near Mayer	09512500	1940-2002	3.59	0.8	0.1	106	2,596

Stream gage data and graphics downloaded from USGS website:
http://water.usgs.gov/az/nwis/

Precipitation Data 2001

Monthly precipitation data are used to assess variations in climatic conditions. Comparisons between recent and long-term precipitation data are useful and aid in the interpretation of water level and surface water data. Precipitation data are also used in the evaluation and quantification of groundwater recharge.

Monthly total precipitation data for the year 2001 were collected for the Prescott (026796) and Chino Valley (021654) precipitation stations. The provisional precipitation data are summarized in Tables 5 and 6. The data indicate the total precipitation at Prescott in 2001 was 12.81 inches or 66 percent of the long-term average. The data indicate that the approximate annual precipitation at Chino Valley was 9.90 inches or 83 percent of the long-term average.

Table 5 Monthly total precipitation in calendar year 2001 Prescott, Az. (inches)

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2001	1.2 b	1.15	1.55	0.60	0.42	0.38	0.90	3.81	0.50	1.08	0.56	0.66	12.81
Long-Term Mean 1898-2001	1.78	1.87	1.77	0.95	0.50	0.41	2.94	3.32	1.74	1.1	1.27	1.67	19.32

Source: www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?azpres

Table 6 Monthly total* precipitation in calendar year 2001 Chino Valley, Az. (inches)

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2001	1.13 b	0.73 b	1.10 d	0.41 d	0.00	0.17 b	0.66 a	2.74 f	1.40 c	0.26 e	0.47 f	0.83 h	9.90
Long-Term Mean 1948-2001	0.97	0.94	0.98	0.57	0.39	0.35	1.94	2.09	1.29	0.84	0.65	0.91	11.93

Source: www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?azchin

(some months during 2001 were missing one or more days of data, therefore monthly and annual total data are considered provisional)
a = 1 day missing, b = 2 days missing, c = 3 days missing, … z = 26 or more days missing
*actual total precipitation may exceed the indicated annual total due to missing days of data, official WRCC annual totals do not include months missing more than 5 days of data.

Groundwater Pumpage 2001

Groundwater pumpage represents the single largest component of outflow from the aquifer system in the Prescott AMA. Groundwater pumpage data provides important information that is used to assess the ever-growing demand on the aquifer system. Groundwater pumpage data are used to compile hydrologic water budgets, and supply well-specific pumpage inputs to groundwater flow models.

Annual groundwater pumpage totals are metered for each non-exempt well in the AMA, and are reported by the well owners to the ADWR. These data are tabulated in Table 7 for the period 1990 to 2001. The 2001 non-exempt well pumpage total in the Prescott AMA was 18,171 acre-feet (Table 7). The 2001 non-exempt pumpage was about 16 percent greater than the average annual non-exempt pumpage of 15,724 acre-feet during the last 12 years (Table 7).

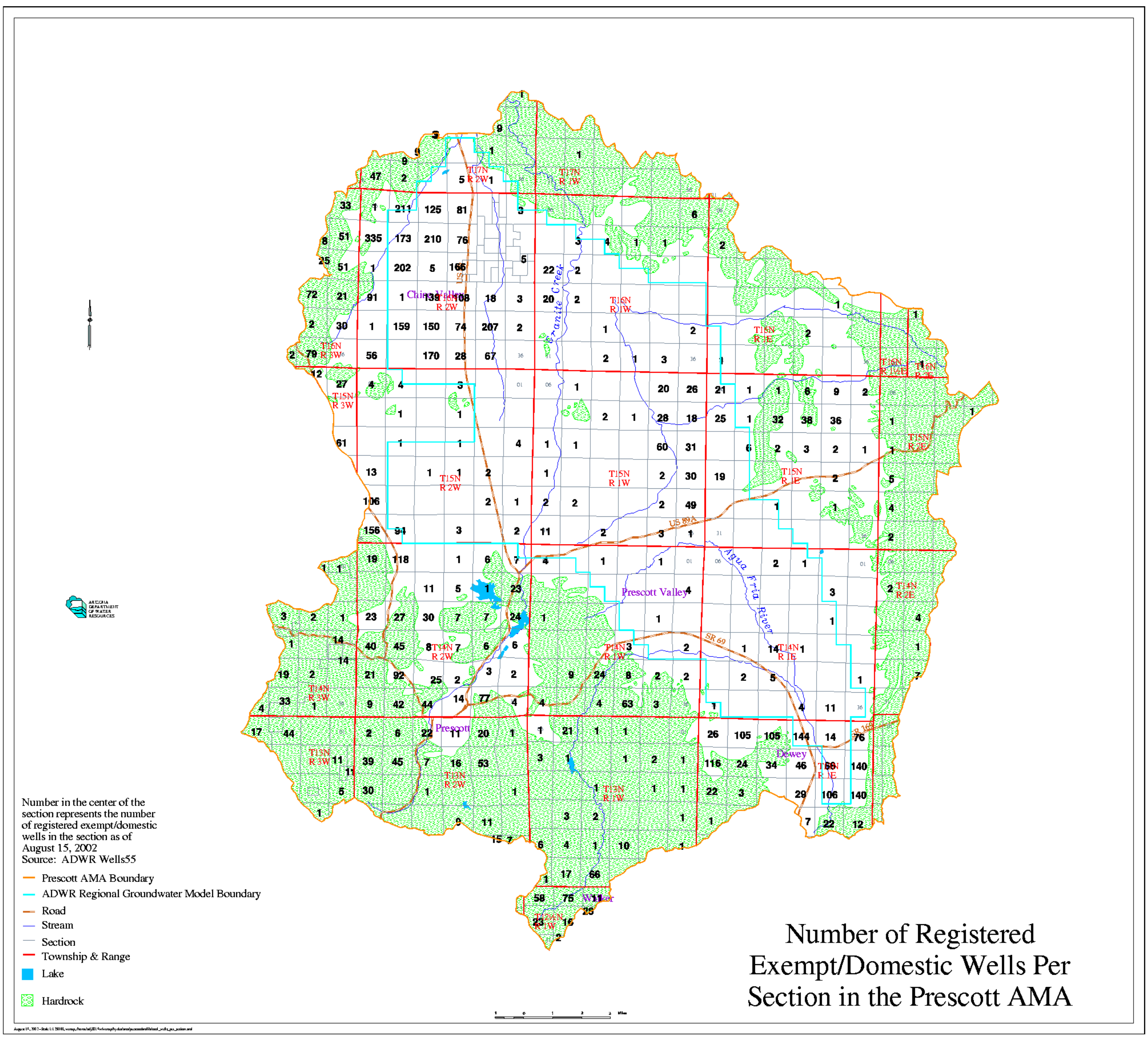
Table 7. Reported non-exempt well pumpage in the Prescott AMA (1990 - 2001)

Year	Pumpage (Acre-feet)
1990	16,088
1991	13,780
1992	12,007
1993	15,279
1994	15,426
1995	15,011
1996	17,635
1997	17,132
1998	15,229
1999	15,642
2000	17,291
2001	18,171
1990-2000 Total	188,691
1990-2000 Average	15,724

Exempt wells (registered wells that may not be equipped with a pump that can withdraw more than 35 gallons per minute), which are also commonly referred to as domestic wells, account for a substantial volume of pumpage in many parts of the AMA. Exempt wells often supply the water needs for residents that do not live within the service area of a local water provider. Large concentrations of exempt wells are found in the Chino Valley area, and in areas that surround the regional aquifer system where wells are often drilled in comparatively thin, marginally productive alluvial deposits and/or volcanic rocks and bedrock (Williamson Valley, Lonesome Valley, Coyote Springs, Dewey, Humboldt, etc.) (Figure 3). The total number of well registration filings for existing or proposed domestic or exempt wells that are located within the Prescott AMA, and for which no well abandonment filing had been submitted, as of 08/15/2002, was 9,543. However, it is known that many proposed wells are never drilled, and the total number of confirmed, drilled domestic or exempt wells in the AMA, as of 08/15/2002, was 7,726 (Figure 3). The number of confirmed, drilled domestic or exempt wells that are located within the groundwater basin area of the AMA, as defined by the Prescott AMA regional groundwater model area (Figure 3), was 3,466.

Pumpage from exempt wells is not reported to the ADWR, and therefore must be estimated. Average annual pumpage for exempt wells located within the groundwater basin area of the AMA has been estimated at .5 acre-feet/year per well (Corkhill, and Mason, 1995). Pumpage for exempt wells located in the marginally productive areas that surround the groundwater basin portion of the AMA has been estimated by Remick (2002) to be about .33 acre-feet/year per well. Applying those rates to the population of confirmed, drilled domestic or exempt wells provides a reasonable estimate of the total exempt well pumpage in the AMA of about 3,100 acre-feet/year. The pumpage being apportioned at about 1,700 acre-feet/year for the groundwater basin area and 1,400 acre-feet/year for the surrounding foothills and mountainous bedrock areas.

Figure 3 Number of registered exempt/domestic wells in Prescott AMA (as of 8/15/2002)



Monitor Well Drilling

During the summer and fall of 2001 the ADWR supervised and financed the drilling of three exploration-monitor wells in the Prescott AMA. The drilling project was identified as an important component of the overall plan to improve groundwater monitoring and hydrogeologic data collection in the Prescott AMA (ADWR, 2001). The well sites are located in the Little Chino sub-basin of the Prescott AMA on State Trust land (Figure 2). The sites were acquired from the State Land Department under Right-of-Way lease number # 18-106000. The cost of the 10-year right-of-way lease for the three well sites was about $6,500. The well sites were selected in data deficient areas of the regional aquifer system where data on water levels and aquifer characteristics were comparatively unknown.

The monitor wells were drilled from June through October of 2001 by the Del Rio Drilling and Pump Company of Chino Valley, Arizona under the authority of State Procurement Office Contract #AD010207. Various phases of the drilling operations are shown in Figures 4 to 7. The casing completion schedules and preliminary well logs for the three wells are shown in Figures 8 to 10 and Tables 8 to 10, respectively . After the wells were drilled the USGS preformed x-ray diffraction analysis on several samples of the drill cuttings from each well. The additional analysis data has been very useful in further confirming and refining lithologic interpretations.

Drilling operations on ADWR-Prescott AMA Monitor Well #1, B(15-01) 08DAA -- (55-587403), began during the week of June 11, 2001. The well was drilled to a total depth of 840 feet below land surface (BLS). The well was geophysically logged on June 18, 2001 by Mr. Raymond Federwisch with Geophysical Logging Services of Chino Valley, Arizona. The well was completed during the week of June 18, 2001. The total cost charged by Del Rio to drill Monitor Well #1 was $42,996.

Drilling operations on ADWR-Prescott AMA Monitor Well #2, B(16-01) 23ACA -- (55-587404), began during the week of June 25, 2001. The well was drilled to a total depth of 654 feet BLS. The well was geophysically logged on July 9, 2001 by Mr. Raymond Federwisch with Geophysical Logging Services of Chino Valley, Arizona (Figure 5). The well was completed during the week of July 16, 2001. The total cost charged by Del Rio to drill Monitor Well #2 was $34,470.

Drilling operations on ADWR-Prescott AMA Monitor Well #3, B(15-02) 22AAB -- (55-588619), began during the week of September 10, 2001. The well was drilled to a total depth of 1,240 feet BLS. Once drilling was completed the borehole was geophysically logged by Mr. Raymond Federwisch with Geophysical Logging Services of Chino Valley, Arizona. The well was completed during the week of October 22, 2001. The total cost charged by Del Rio to drill Monitor Well #3 was $60,000.

Figure 4.. ADWR Director Joseph C. Smith (left) and Prescott AMA Director Jim Holt (center) confer with Del Rio driller Leon Bonner (right) during a drill site inspection to Monitor Well #1, B(15-1) 08DAA. Drill cutting samples are assembled on plastic tarp in foreground

Figure 5 Water production from well B(16-1) 23ACA

Figure 6 Geophysical Logging Services logging truck on site at well B(16-1) 23ACA

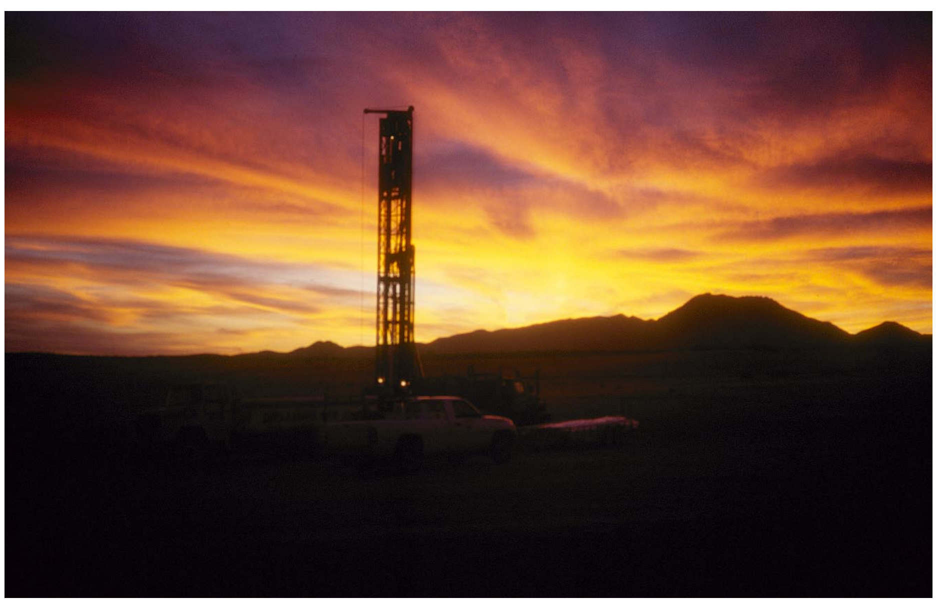


Figure 7 Sunset behind Granite Mountain provides a picturesque backdrop and tranquil end for hard-fought drilling operations at the B(15-2) 22AAB well site

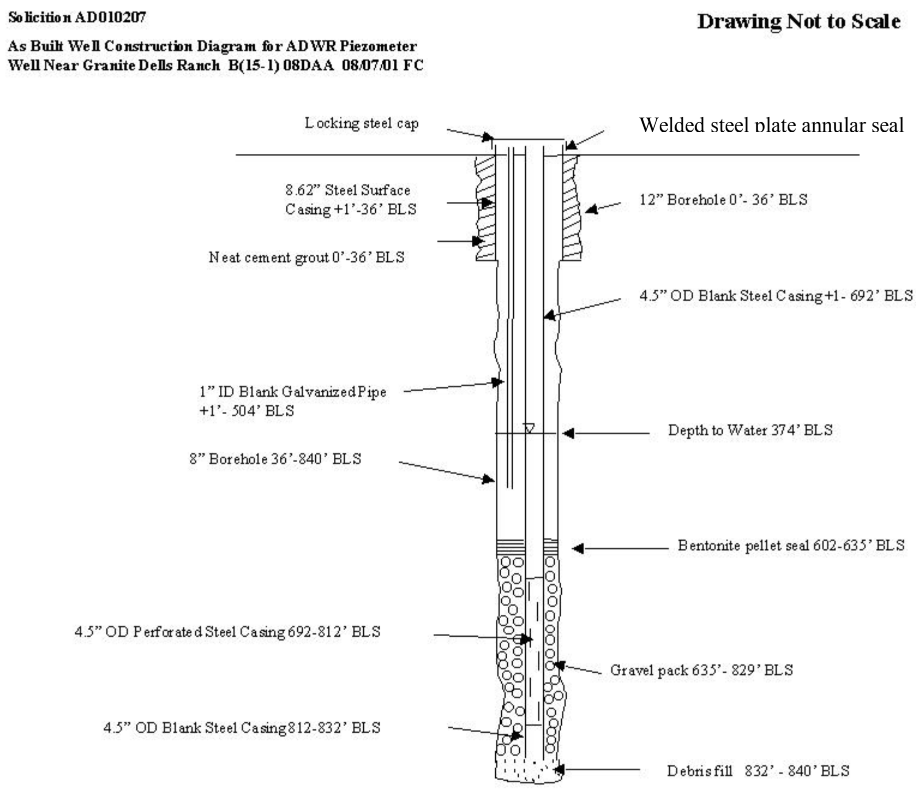


Figure 8 As-built well construction drawing for B(15-1) 08DAA

Interval Top Feet (BLS)	Interval Bottom Feet (BLS)	Description
0	32	Soils
32	55	Clayey, very fine sand
55	580	Basalt flows and cinders (water level 374') lots of water below 374' ~ 300 gpm
580	604	Tuff ?
604	685	Cinders and basalt flows
685	695	Hard basalt flow
695	808	Sand and gravel, basal conglomerate? (more water ?)
808	840	Schist fragments and granitic material

Table 8 Preliminary geologic log based on field interpretation of drill cuttings B(15-1) 8DAA

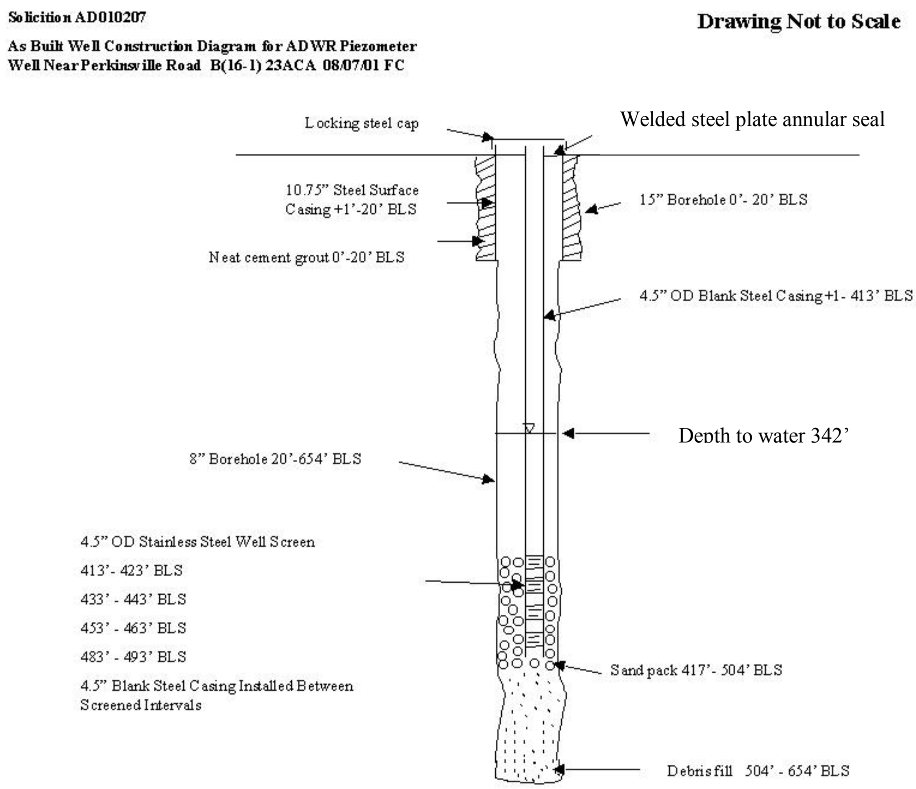


Figure 9 As-built well construction drawing for B(16-1) 23ACA

Interval Top Feet (BLS)	Interval Bottom Feet (BLS)	Description
0	112	Clayey gravel
112	135	Basalt
135	260	Mostly cinders
260	380	Basalt flow
380	400	Burned gravel or tuff
400	430	Tuff-like
430	440	Sand
440	450	¼" pebbles
450	485	Coarse –fine sand
485	496	Green Material? – very soft pebbles, cemented
496	590	Red sand - purplish color ~ 40 min/rod
590	620	Brownish color – no rounded fragments ~1 hour/rod (monzonite)
620	640	Brownish color – no rounded fragments ~2 hour/rod (monzonite)
640	654	Brownish color – no rounded fragments some biotite ~ 2.75 hour/rod (monzonite)

Table 9 Preliminary geologic log based on field interpretation of drill cuttings B(16-1) 23ACA

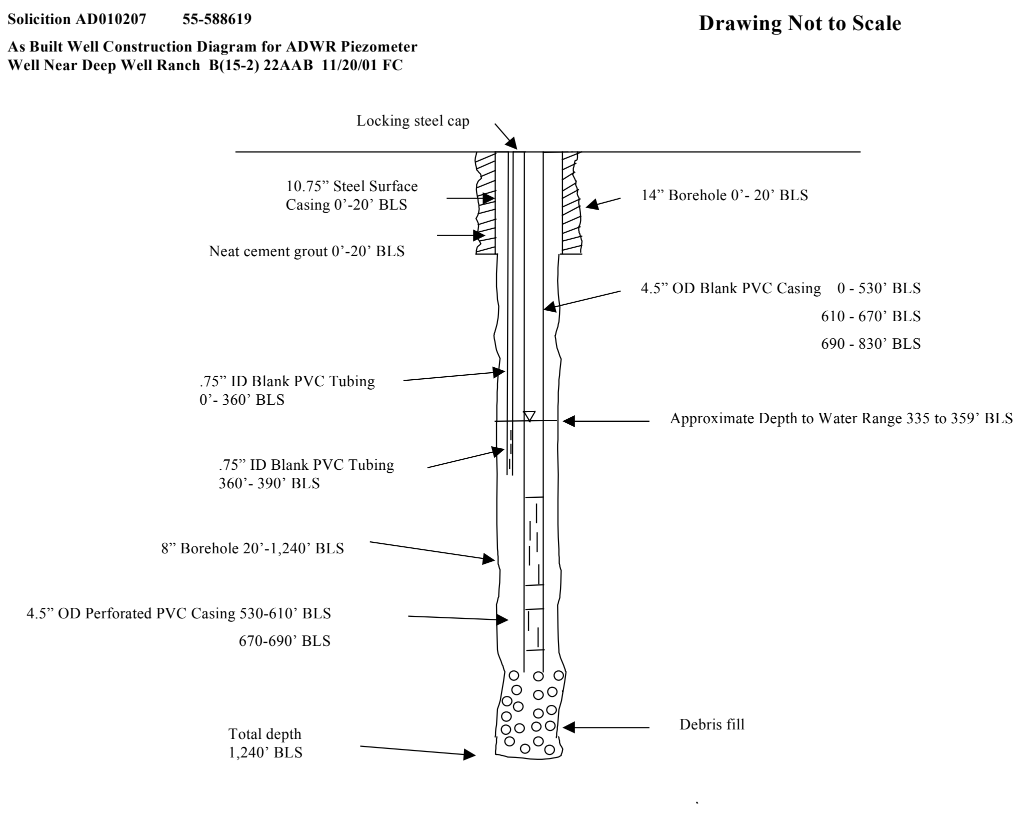


Figure 10 As-built well construction drawing for B(15-2) 22AAB

Interval Top Feet (BLS)	Interval Bottom Feet (BLS)	Description
0	2	Soils
2	10	Sand and gravel
10	50	Clay and some sand
50	694	V. coarse sand, gravel and clay (conglomerate)
694	704	Mudstone, some sand
704	724	Probably basalt
724	764	Mudstone, some sand
764	782	Mudstone
782	802	V. coarse sand, gravel and clay (conglomerate)
802	1,107	Mudstone, minor sand and gravel
1,107	1,114	Probably Basalt
1,114	1,190	Mostly mudstone, minor sand
1,190	1,210	Decomposed granite?
1,210	1,240	Granitic material (very hard drilling)

Table 10 Preliminary geologic log based on field interpretation of drill cuttings B(15-1) 8DAA

Prescott AMA Groundwater Model Update

The first update of the Prescott AMA groundwater flow model (Corkhill and Mason, 1995), which is one of key components of the Prescott AMA monitoring program, was completed during 2001 (Nelson, 2001). The update of the model began in 1999, and was based on the availability of new hydrogeologic data collected since the original model study was completed in 1995. The update also provided the opportunity to review and modify certain components of the steady-state and transient groundwater budgets (natural recharge and steady-state pumpage) through the model calibration process. Modifications to the model's structure and hydraulic properties included the extension of the LVU slightly farther to the south into the northern part of the Upper Agua Fria sub-basin in Prescott Valley area and modifications to aquifer transmissivities, where appropriate. The transient calibration period, which originally ended in 1993, was also extended to include 5 additional years of data through 1998. Due to timing, the model update was completed before the drilling of the 3 new monitor wells, and it was not possible to incorporate the new hydrogeologic data from the monitor wells into this first model update. However, the next model update will incorporate the new data.

The updated model was used to simulate future groundwater conditions in the AMA through 2025 (Nelson, 2001). The assumed future water use scenarios were developed in cooperation with the major water providers and groundwater users. The results of the planning simulation indicated the following:

- Most locations within the model area will continue to experience long-term declines.

- The generalized decrease in hydraulic head throughout the LIC is projected to further decrease groundwater discharge near Del Rio Springs.

- Water levels in the UAU aquifer are projected to generally increase throughout much of the southern portion of the UAF due to effluent recharge thus resulting in an increase in groundwater discharge in the Agua Fria River.

2001 Conceptual Water Budget

A conceptual water budget has been prepared from the assembled 2001 pumpage, recharge and surface water discharge data. Estimates of long-term natural recharge that have been developed from the Prescott model update are used for that water budget component. The 2001 conceptual water budget for the Prescott AMA which is summarized in the Table 11 indicates that groundwater outflows exceeded inflows, resulting in a –11,510 acre-foot overdraft for the year.

Table 11 Conceptual Water Budget (2001) – Prescott AMA
(Figures rounded to nearest 10 acre-feet)

Groundwater Inflows	**2001 Volume (acre-feet)**
Natural Recharge (1)	5,750
Incidental Recharge (2)	2,260
Artificial Recharge:	
(City of Prescott) (3)	3,020
(Prescott Valley) (4)	1,700
Total Inflows	12.730
Groundwater Outflows	
Groundwater Pumpage:	
Non-Exempt (5)	18,170
Exempt (6)	1,700
Groundwater Discharge:	
Underflow to Big Chino (7)	1,800
Del Rio Springs Discharge (8)	1,230
Agua Fria Baseflow near Humboldt (9)	1,340
Total Outflows	24,240
Inflow – Outflow = (Overdraft)	-11,510

(1) Estimate for average annual mountain front recharge (Nelson, 2001, pg. 9).
(2) Estimated at 50% agricultural water use for 2001 (Corkhill, and Mason, 1995, pg. 58), (Nelson, 2001, pg. 9).
(3) Includes treated effluent and surface water. 2001 - City of Prescott Annual Underground Storage Facility Report-Schedule 71.
(4) Data provided by Neil Wadsworth – Town of Prescott Valley (8/1/2002 personal communication to Frank Corkhill). Includes effluent recharged in channel of Agua Fria River and in PV lakes.
(5) ADWR Registry of Groundwater Rights database.
(6) Estimated domestic and exempt well pumpage in Prescott AMA groundwater basin area only. 1,400 acre/feet per year of additional domestic well pumpage estimated for surrounding mountainous area (see pumpage section of this report for further details).
(7) ADWR model simulated underflow to Big Chino in 1999 (Nelson, 2001, pg. 13, Table 5).
(8) USGS 2001 annual discharge at Del Rio Springs gage (09502900). Note! Unquantified diversions of groundwater discharged from the cienega above the USGS Del Rio Springs gage are not reflected in the gage's annual total. Also a minor, unquantified volume of groundwater supports a small riparian area in the immediate area of the springs. Total 1999 ADWR- model simulated groundwater discharge including undifferentiated ET component at Del Rio Springs = 1,800 AF/yr (Nelson, 2001, pg. 13, Table 9).
(9) USGS 2001 annual discharge at the Agua Fria gage near Humboldt (09512450). Annual discharge not reduced to account for minor surface water runoff. Total 1999 ADWR – model simulated groundwater discharge including a minor undifferentiated ET component to Agua Fria River near Humboldt = 1,400 AF/yr (Nelson, 2001, pg. 13, Table 9).

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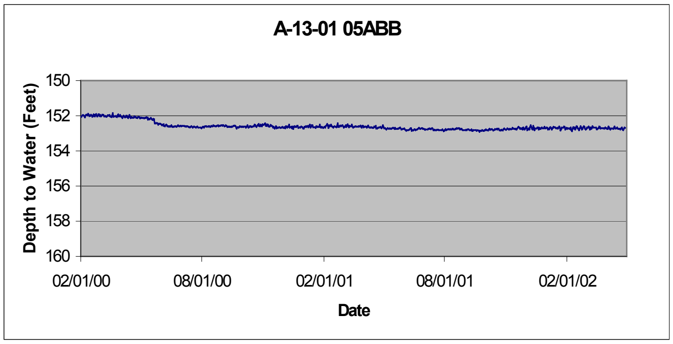
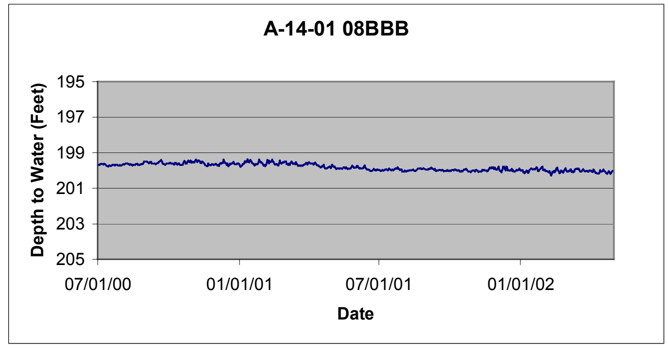
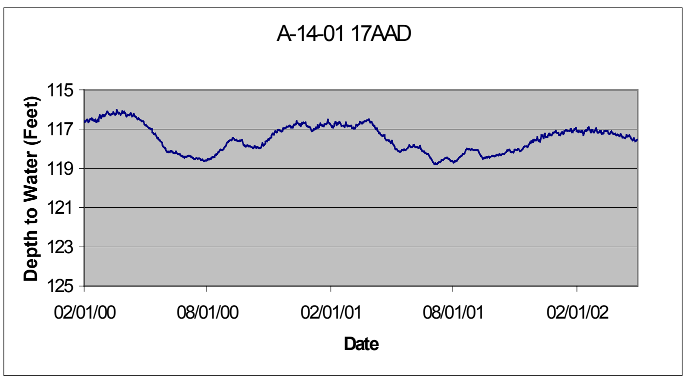
Appendix A -- Hydrographs of Prescott AMA Transducer Wells

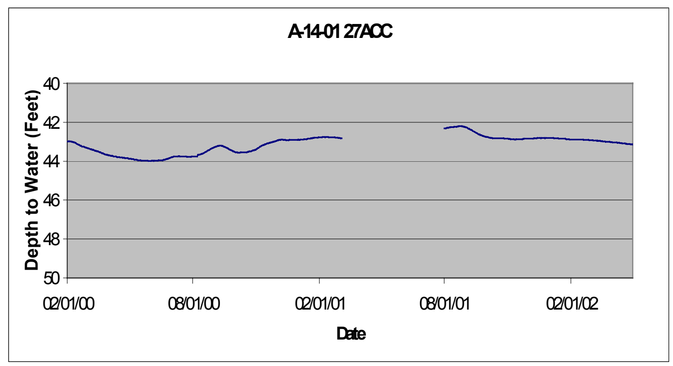
Upper Agua Fria (UAF) Sub-basin

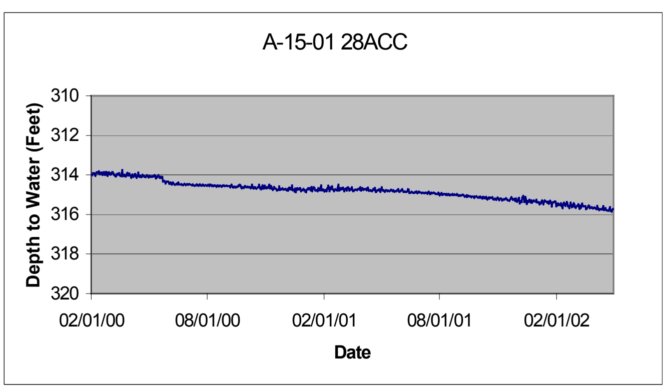
(Note! Horizontal and vertical scales vary on hydrographs)

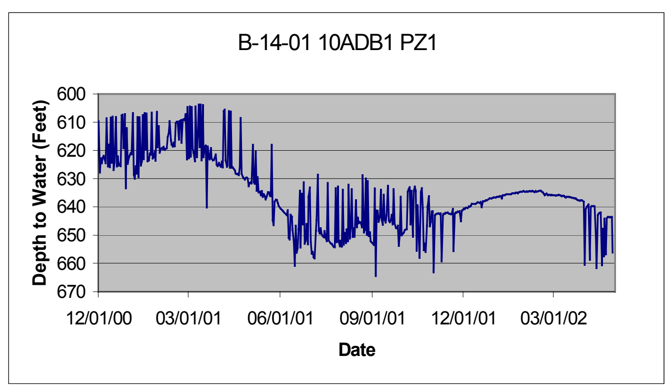




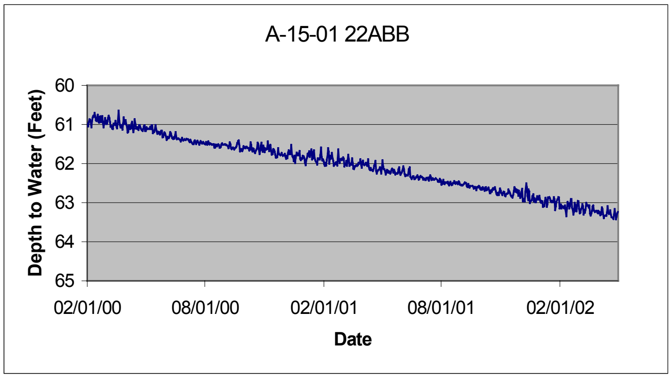


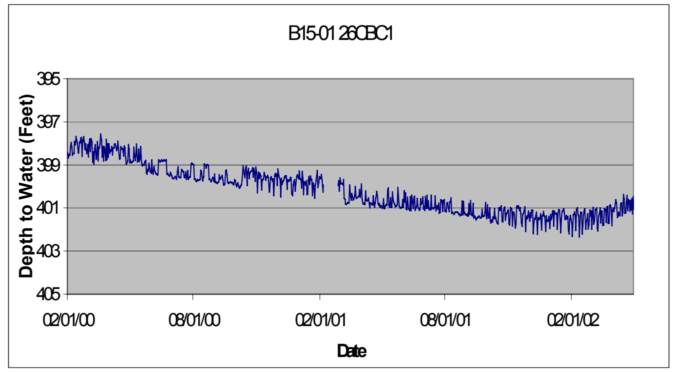


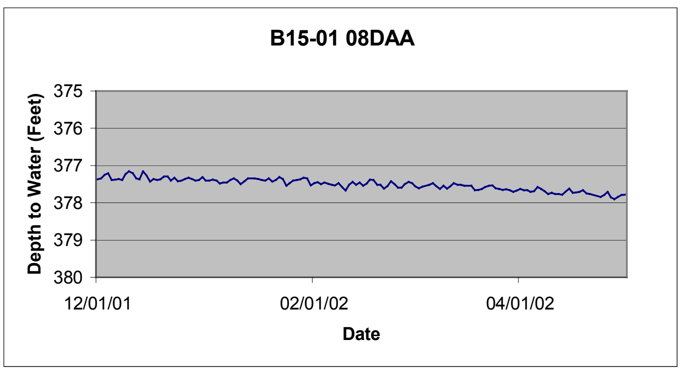


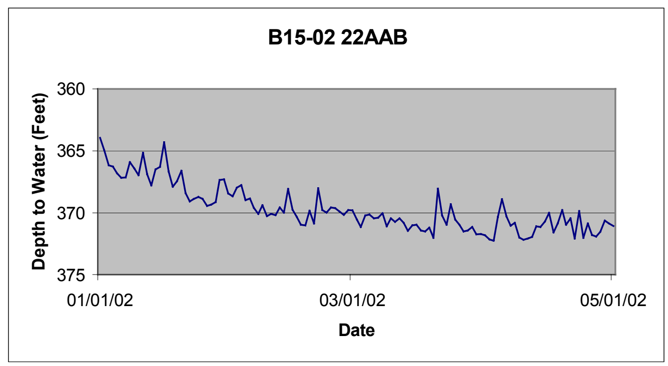


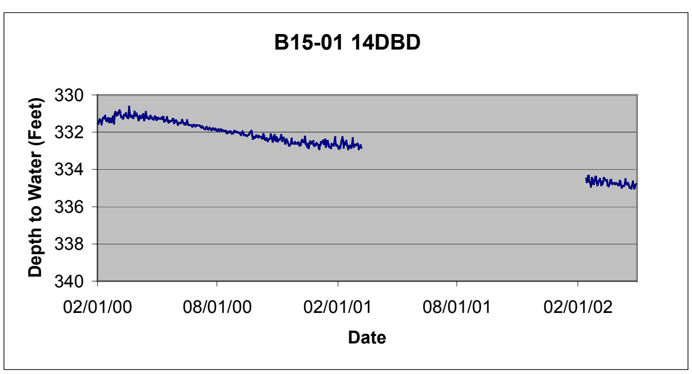
Appendix A -- Hydrographs of Prescott AMA Transducer Wells
Little Chino (LIC) Sub-basin
(Note! Horizontal and vertical scales vary on hydrographs)

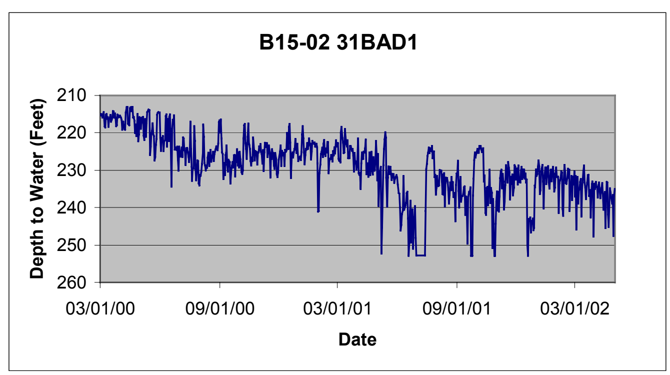








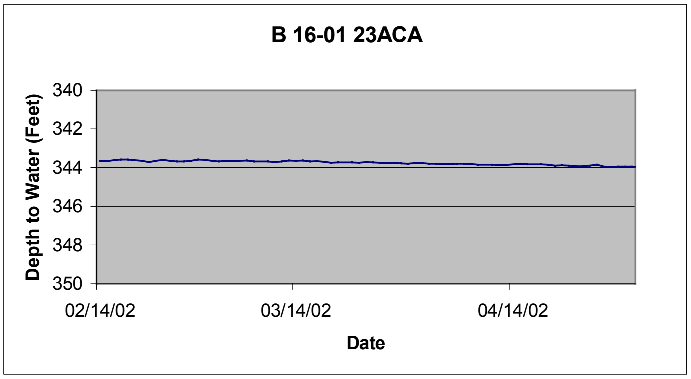


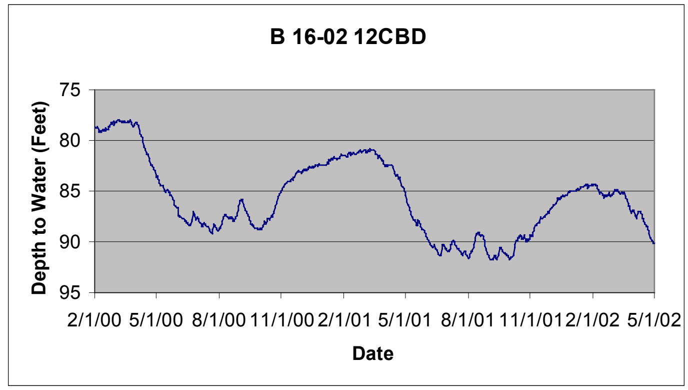


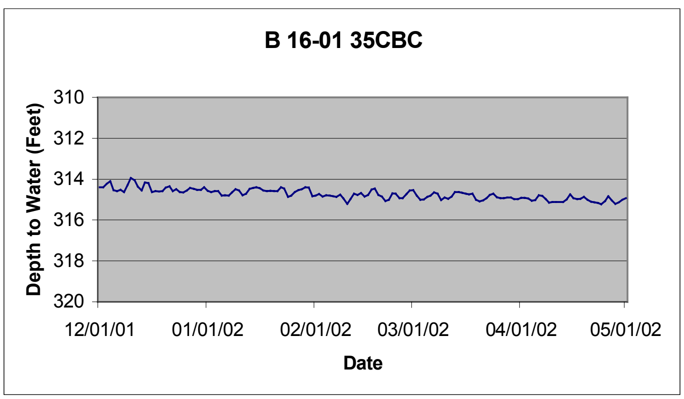
Appendix A -- Hydrographs of Prescott AMA Transducer Wells

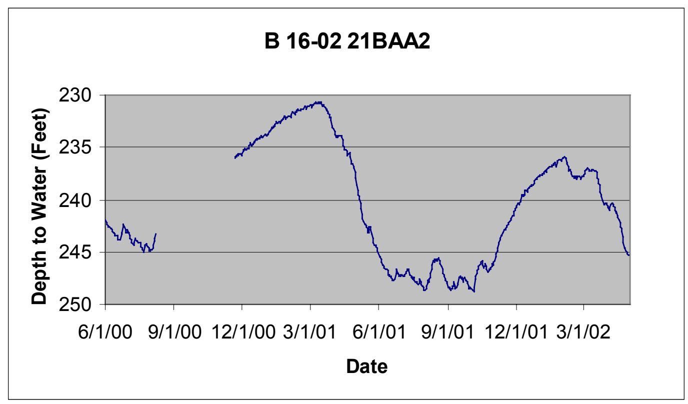
Little Chino (LIC) Sub-basin

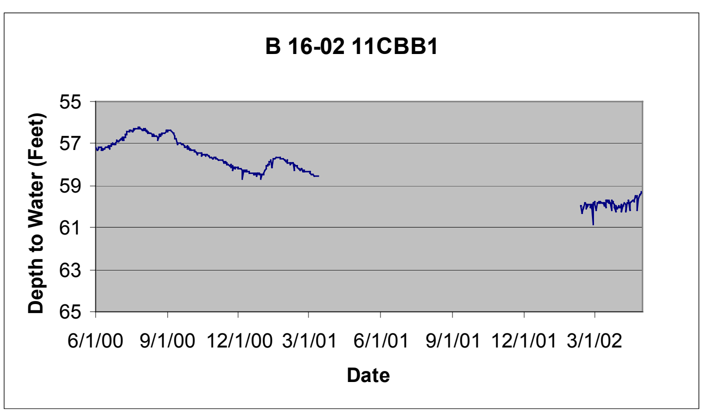
(Note! Horizontal and vertical scales vary on hydrographs)

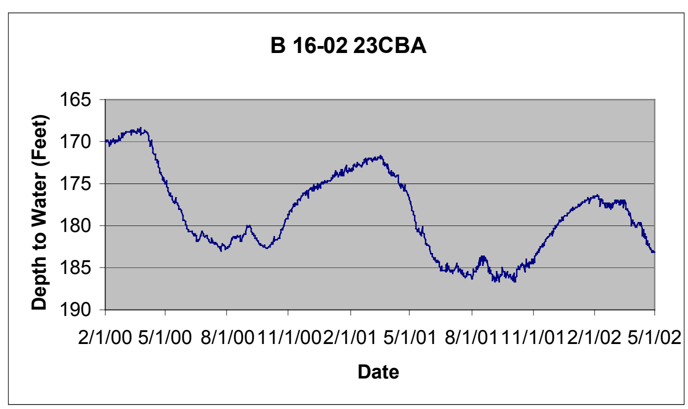




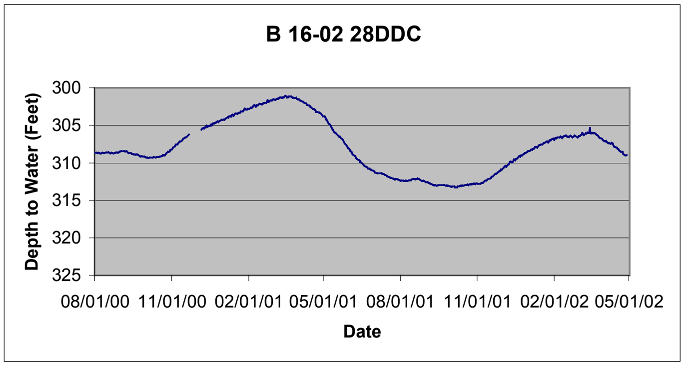


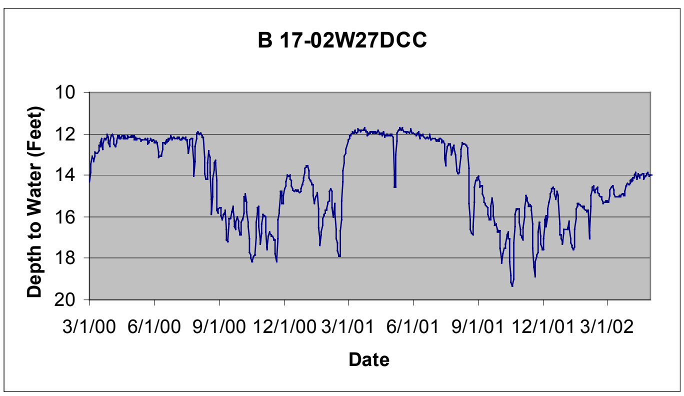


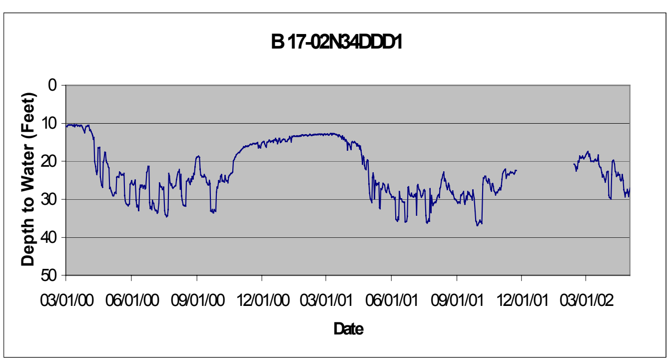




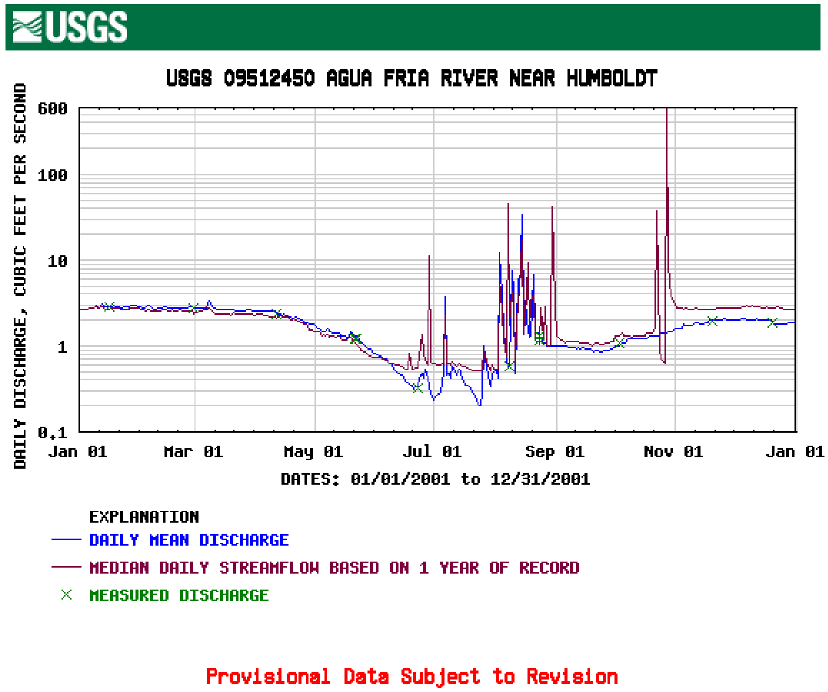
Appendix A -- Hydrographs of Prescott AMA Transducer Wells
Little Chino (LIC) Sub-basin
(Note! Horizontal and vertical scales vary on hydrographs)

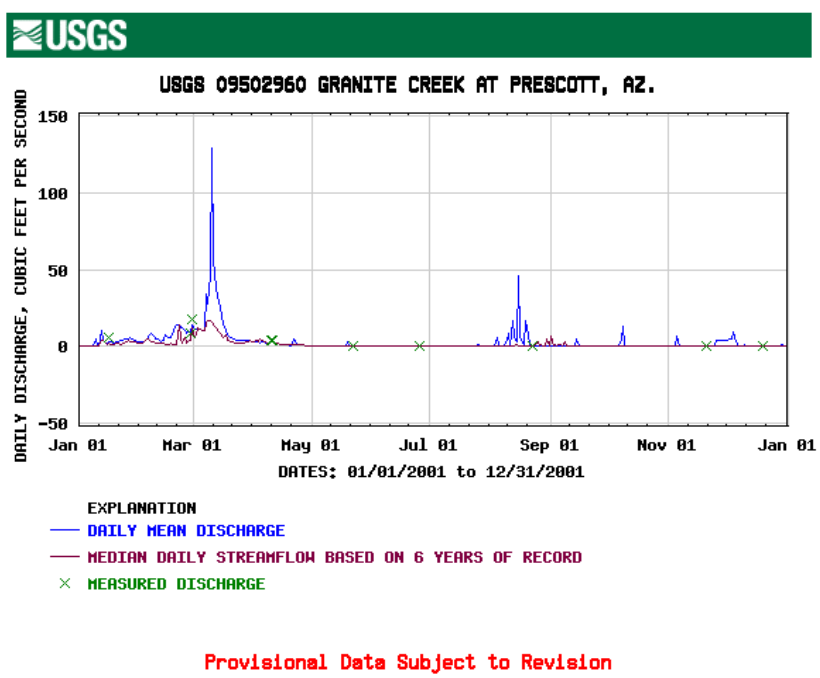




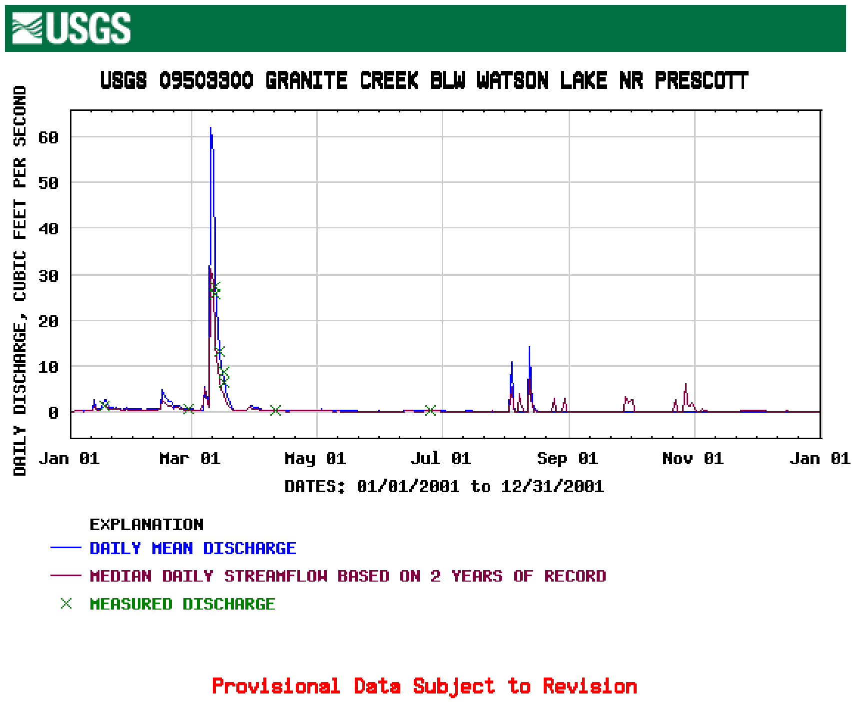


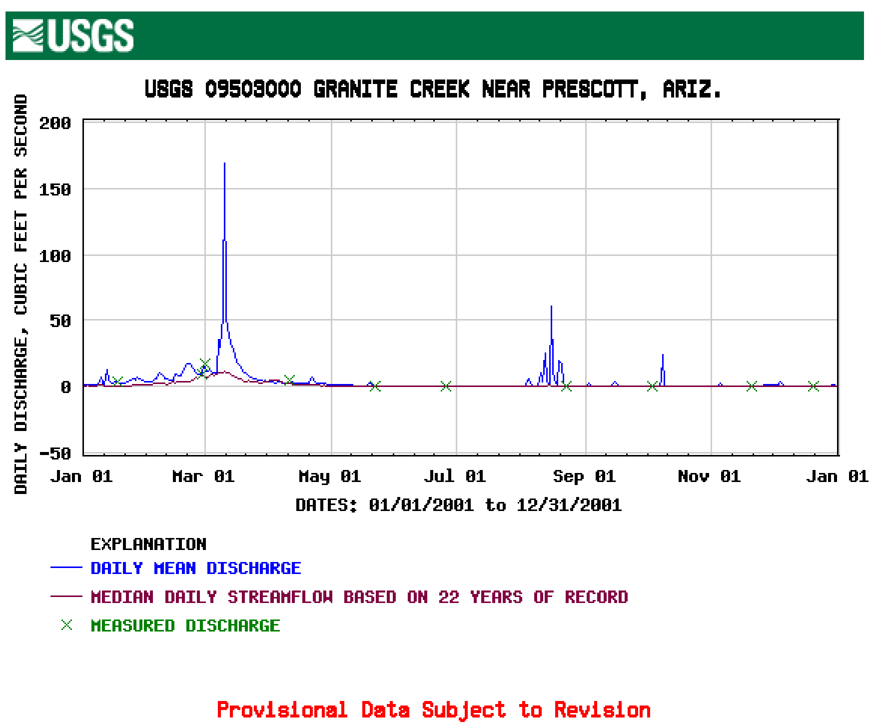
Appendix B - Daily discharge hydrographs for selected USGS streamgages



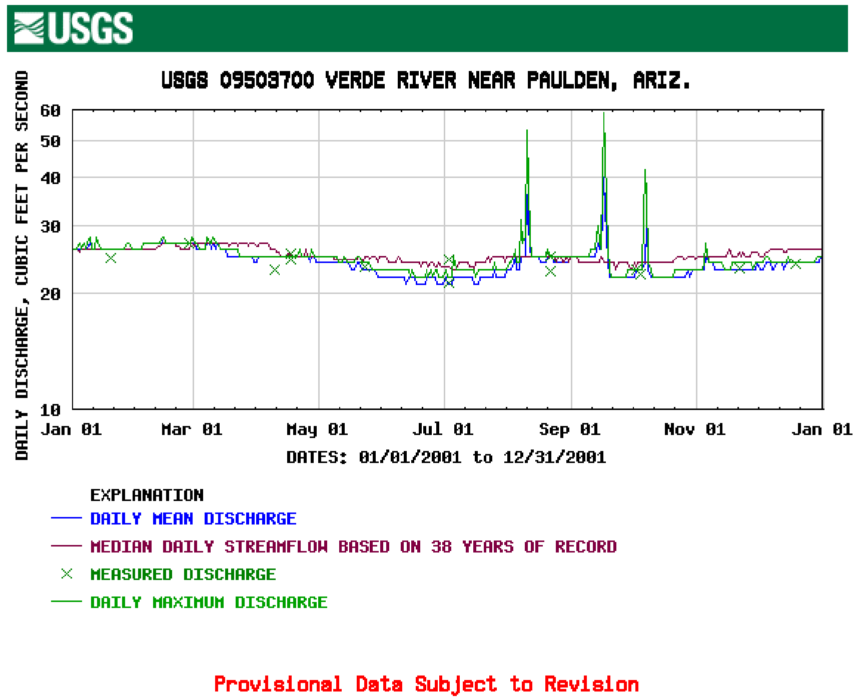


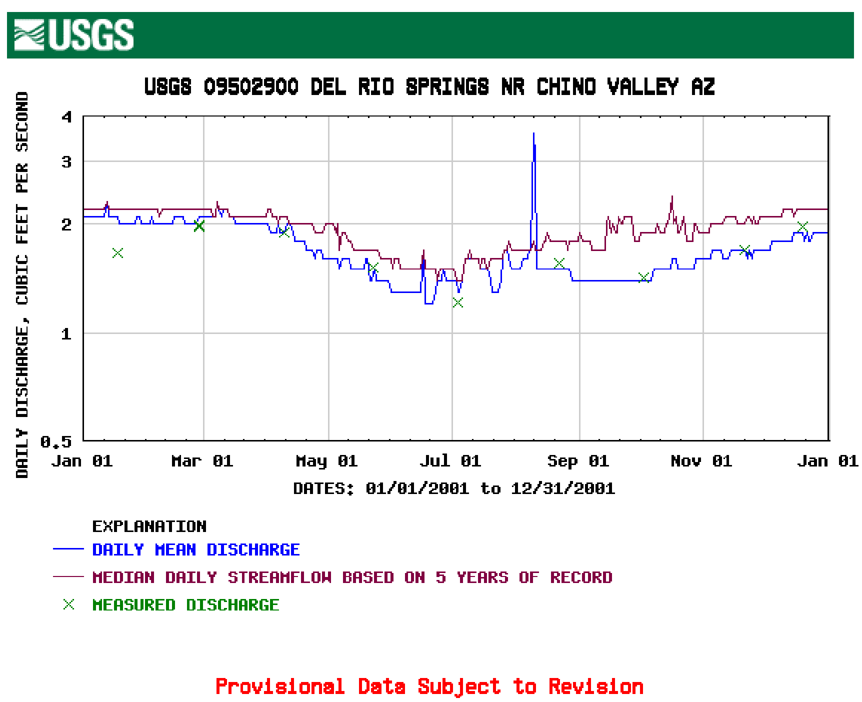
Appendix B - Daily discharge hydrographs for selected USGS streamgages





Appendix B - Daily discharge hydrographs for selected USGS streamgages





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